Historic American Engineering Record

HAER PR-6

Hacienda Santa Elena: AZUCARERA
Sugar Mill Ruins
Toa Baja
~~Guayama Co.~~ Municipality of Toa Baja
Puerto Rico

HAER
PR.
75-TOBA,
1A-

REDUCED 8" x 10" DRAWINGS

Addendum to:
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Municipality of Toa Baja
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PR,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D. C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

Hacienda Azucarera Santa Elena: Sugar Mill Ruins

PR-6

Location:	Toa Baja, Puerto Rico Route 165, 7.7 KM Quad: Vega Baja & Bayamon
Date of Construction:	1790
Present Owner:	Fonalledas Family
Significance:	The ruins are the only extant remains pertaining to an industrial building in Puerto Rico dating back to the late 18th century. They illustrate the transition from a cattle-driven vertical wooden mill to steam technology. The impressive ruins are a classic example of Spanish Colonial architecture --in proportion, design, and construction-- applied to sugar manufacturing needs.
Historian:	Benjamin Nistal-Moret, Historian
Transmitted by:	Jean P. Yearby, 1984

After several weeks of archival research in the municipal records of Toa Baja and the General Archives of Puerto Rico, it has been impossible to find any significant primary evidence relating to the formation, construction, industrial development, and functioning of Hacienda "Santa Elena." The owners of the property, the Fonalledas, have no significant information either, the mill and surrounding lands became part of the Fonalledas' estate in 1911.

The available information is limited to two secondary sources [1]: an eyewitness interview (a HAER drawing titled "Approximate location of machinery based on corroborated eyewitness evidence" [2], and four 1910 site photographs. [3]

The sugar mill, Hacienda "Santa Elena," was built in 1790 by Juan Rijus Feduchi. [4] In the late 1820s, the property was sold to a Dr. Figueras. Between the 1820s and 1891, when the hacienda was sold again, this time to Jaime Fonalledas, extensive changes were introduced in the mechanical aspects of its sugar-producing equipment, as well as to its architecture.

Between 1790 and the 1830s, the sugar mill was a vertical wooden cattle-driven device. The evidence states that a steam-powered mill was introduced "between 1830 and 1839." [5]

Since it is common knowledge that the first steam engine was introduced on the island in 1839, it can be ascertained without reservations that Hacienda "Santa Elena" was one of the first Puerto Rican sugar mills to have been partially mechanized. On the other hand, the research performed by the 1977 HAER historian team in Puerto Rico found that the first steam engine in Puerto Rico was already in operation in Ponce in 1831. [6]

The introduction of a steam engine in "Santa Elena" was carried out by Dr. Figueras who also "rebuilt the factory." [7] Later in the century, when the property was purchased by Jaime Fonalledas, new technical and structural changes were introduced into the old sugar mill. Nevertheless, the same evidence also states that the site, in 1902, "still preserves all its old architecture, whose formidable masonry walls, which belong to the old factory, reflects the colossal sugar industry of last century." [8]

According to the evidence and oral sources, there is little doubt that the factory building, as it stood in 1902, sheltered the old steam engine, a double flue boiler, two clarifiers, a five-vat Jamaican train, and twelve crystalizers, plus a rum distillery with its tanks and mixing pans. There were also purging and curing houses for the sugar hogsheads.

The same sources indicate that out of the 500 acres which originally formed the hacienda, only 100 acres were planted with sugar cane which required a labor force of 50 workers. The hacienda produced approximately 300 hogsheads of mascabado sugar per harvest.

* * * *

On July 6, 1977, Geronimo Fonalledas, co-owner of the hacienda, was interviewed in his office by the HAER team historians. [9] Questioned about the present hacienda ruins and old structures, he said, first, that the "old arches" of the sugar mill -- referring to the old brick and plaster ones dating back to the 18th century -- were reinforced with brick supporting columns as a result of the vibrations created by the 1830's transformation of the factory from a cattle-driven mill into a steam-powered factory. Second, he said that the buttresses on the west facade were built as reinforcements against these vibrations and the excessive erosion of the river banks, which were dangerously close to the old building's foundations. The cast iron columns, cast iron arches, and connecting rods on the north room were incorporated into the old structure for the same reasons and to "vive more strength to the building."

He stated that the old wooden mill was replaced by a Mirrlees & Watson steam engine. The new engine had a vertical cyclinder but lacked a beam. It was fed by a double flue boiler which was fired with sugar cane straw and fueled with bagasse. He pointed out that the boiler was "somewhat distant from the mill."

The factory had two cast iron clarifiers. The sugar cane syrup, or "guarapo," was pumped into the clarifiers by a "two arm donkey pump" and steam heated by a copper pipe 3 to 4 inches in diameter, connected to the boiler or steam engine. From the clarifiers, the "guarapo" was manually transferred to the 5 vat Jamaican train which ran south to north and was stationed in a room --no longer in existence-- northwest of the north room.

He described the sugar reduction process that took place at the Jamaican train as "beautiful" since, he pointed out, "the sugar cane molasses was transferred from one vat to the next with a rhythmic rowing movement." With juvenile spontaneity, he imitated the rowing movement he had seen at the sugar mill more than seventy years ago when he was 10 or 12 years old. He said, as he kept "rowing," that each vat had an "oar" to which a receptacle similar to a bucket was attached: each "oar" had its own fulcrum. The men in charge of the Jamaican train --he was still imitating the movement-- dipped the bucket on the next vat's rim, emptied it on the next vat. Then, slowly, the "oar men" rhythmically moved back to begin the same operation.

The mascabado sugar was transferred from the crystallizers to the purging house and poured into the hogsheads. The sugar was carried in buckets. These were built in the hacienda's carpentry shop from imported wood. The bracing, though, was made from native wood, contrary to the rum caskets' and barrels' which were made of metal forged in the hacienda's smithshop.

The hacienda, he continued, had a rum distillery located north of the Jamaican train and the crystallizers' room. The still had the usual equipment: boiling pans, fermenting vats, copper serpentines; mixing pans, etc. The rum was produced from the defecator's residues,

molasses, purged molasses, and molasses residues from crystallizers. Both the mascabo hogsheads and the rum barrels were shipped down the La Plata River to San Juan Bay through the Cocal Channel.

Finally, he concluded that he knew all these things because he saw them as a child. He recalled that the sugar mill was in operation just prior to World War I when it was dismantled --along with the rum still-- and was sold as scrap iron to the Abarca Foundry in San Juan. He added that the mill he saw at "Santa Elena" was the same as the one installed in the 1830s. Therefore, and considering this fact, "the mill was doomed to disappear because it was inefficient by the standards of the great mechanized factories at the turn of the century." The mill's inefficiency resulted from the old system of sugar production based on the intensive use of an expensive labor force by "Santa Elena" standards. The sugar industry of the early 20th century was based both on an expensive labor force and a more elaborate technology, both of which outreached the hacienda's economic capacities. Thus, the reasons for dismantling the mill. [10]

On August 3, 1977, Geronimo Fonalledas was again interviewed [11] with the purpose of making an "Approximate location of machinery based on verified eyewitness evidence" drawing. [12] As a result of the interview, it was possible to locate --besides the old mill-- the ruins of the north facade which had not been previously recorded. [13]

It should be pointed out for the sake of accuracy, that Geronimo Fonalledas refused to fix an approximate location of the machinery on the HAER architects' drawings since "children perceive things in a different scale than grownups." Nevertheless, he was willing to go with the HAER team to "Santa Elena" and, in situ, only in an "approximate way," point out the machinery and equipment location as he saw them as a child. For, as he said, talking about the past "pleases me and makes me happy." Don Geronimo was very careful not to validate his own statements concerning the exact location of the machinery. He solemnly confessed that was the "historian's job, I am an old engineer."

From the very beginning, he determined that the hacienda was "a self sufficient unit," since everything was produced and manufactured on its premises, with the exception of the sugar hogsheads and rum casks which were probably brought from Canada.

The interview began on the ramp's eastern side. [14] He pointed out that the first room underneath the ramp was a small dungeon, and that the second room closest to the southern facade was used for storage. The interview proceeded to the south room of the present structure where the first cattle-driven vertical wooden mill had been installed on its second floor, both of which are no longer in existence. [15] The slaves carried the sugar cane up the ramp to the mill. The oxen moved along a circular ramp pulling the vertical crushers. He was

asked if he actually saw the mill. He said no, that he was not so old, but that he had been told it was so. But, he added, a series of square holes in the south room walls where the beams that supported the second floor used to rest, can still be seen.

For the lack of other evidence, it can safely be inferred from these statements and from the architectural and structural continuity between the south and north rooms, that the 1790's and 1830's primitive Jamaican train and crystallizers were located in the north room. By architectural and structural continuity is meant, first, the basic delineation of the working industrial spaces; and second, the flow of the original brick and plaster internal arches. [16] The exteriors tend to corroborate this argument [17] even with the decorative details, such as the first subsidiary cornice, the belt course, the second subsidiary cornice, and the main cornice. [18] If all these are contrasted with the north elevation --where later additions or transformations were introduced-- and the west elevation --where similar changes occurred--[19], the arguments make more sense. But the eyewitness refused to corroborate or elaborate on these speculations. Be only ventured to state that after the wooden mill was torn down, and the new steam engine was installed in the north room, that the south room became the smithshop and storage area.[20] As he viewed the south room, he pointed to the brick supporting columns and asserted that they were the columns he referred to in the first meeting, built to absorb the structural vibrations created by the steam engine. [21]

As we moved into the north room, he stated the actual site's concrete floor was not the original mill floor, which was 4 to 5 feet lower. He then proceeded to mark the modern machinery's location and to describe the sugar-making process. The main bulk of the machinery was stationed on the northwest section of the north room. First, --from south to north-- was the mill, followed by the reduction gear, flywheel, and the steam engine. The access to the sugar mill crushers was determined by a platform and a ramp. The ramp opened to the east facade through the first arch of the north room. The ramp had the same function as in the old mill: workers and slaves carried sugar cane bundles and deposited them on the platform from where they were fed into the crushers. The bagasse, to be later used as fuel, was collected on the opposite side and carried away on ox carts to the drying sheds. The reduction gears, flywheel, and steam engine were located somewhere between and under the two northwest iron columns and arch in this section of the room. [22]

If the floor problem is now considered --that the original floor was 4 to 5 feet below the existing one-- it can be speculated that there was enough space to accommodate the machinery within the cast iron columns and arches. This is important since it means that what looks like the base of the cast iron column on the concrete floor is but the square top of the rectangular cast columns. [23] If so, the column base must be underground, covered by 3 to 4 feet of dirt and concrete.

As the interview continued, he pointed to the northwest corner of the north room and located the site of the steam-heated clarifiers. He concluded that the rest of the north room was used as a working and service area.

The party moved from the north room through the central door --atop of which is a niche for a religious statue-- into the open space north of the north facade. [24] This is the site of a building no longer existing --approximately 20 to 25 feet high-- where the Jamaican train was stationed on a brick and plaster battlement elevated from the floor. It was a 5-vat arrangement, the largest of which was 6 to 8 feet in diameter. The crystallizers were perpendicular to the east facade and the Jamaican train. The ruins of the flue which fed the train are seen immediately before the first vat. The flue runs underground, under a wall in the northwest section of the northwest corner proper, where the chimney probably stood. [25]

From Mr. Fonalledas' statements, it can be deducted that the boiler might have been stationed between the chimney ruins and the first buttress of the west facade. But, again, he refused to support this assumption, since he was not sure of the exact location. On the other hand, he recalled the existence of a second flue which conducted "gases" to the chimney, although he could not recall its location.

Another structure --completely gone today-- existed perpendicular to the east facade which was connected to the Jamaican train's room. [26] It was the purging --and apparently curing-- house where the hogsheads were lined on a wooden floor to drip the uncrystallized molasses. At the end of this structure, the cask workshop or "toneleria" was located.

The rum still --two stories high-- was at the farthest point north of the Jamaican train. He could not provide more information on this section of the building since, as a child, the rum still was "forbidden land." As this location was inspected, the ruins of the north end wall --the old north facade-- were found.

* * * * *

The available contemporary evidence does not register the existence of any 18th century Puerto Rican industrial building comparable in size to "Santa Elena." It is difficult to ascertain its true significance; although the actual ruins support a direct correlation with the socio-economic importance of the surrounding area in that period. In 1794, the vicinity of Toa Baja County consisted of 220 inhabitants settled on "one of the richest river banks of the Island." As early as 1776, the lands were noted to be fertile enough to produce all kinds of fruits. [27] There were 162 estancias or agricultural farms and 6 "hatos" or cattle ranches. The land was primarily planted in sugar cane (138 acres holding 5th place on the entire island), plaintain (306 acres), coffee (19,682 trees), and cotton (1,379 trees).

Agricultural production was unquestionably high, since the town of Toa Baja became the second most important producer of mascabado sugar (31,740 Kg) and corn (82,800 Kg) on the entire island. [28] The town was also fourth in molasses production. It is significant that agricultural production went hand in hand with product quality. In 1782, one Toa Baja hacendado produced "the best sugar and rum of all the Island" as a result of either the "enlightened character of the owner or the best quality of the land." [29]

It was during this time that "Santa Elena" was built. If the land was famous for its fertility, that same land perpetuated itself in a grandiose, unique, manmade structure. Both were points and counterpoints of a single orchestration: one produced the green sweet sugar cane, the other turned it into the dark sugar, the brown molasses, and the translucent rum. Thus, the lands of "Santa Elena," scissored by La Plata River, asserted its green quality through its untiring, tropical, generating capacity. At the same time, it was crowned by a brick and plaster structure of powerful and magnificent simplicity which somehow recalled the religious intimacy and serenity of the arcade of the St. Thomas Aquinas Dominican Convent and the overwhelming arched and vaulted militarism of St. Christopher Castle, both in the Old Walled City of San Juan.

* * * * *

The approach to the ruins of the old factory is towards the east facade. It is a two-story building. South of the east facade is the entrance ramp to the second floor. North of the east facade everything is in ruins. [30]

The facade's "stories" or "floors" are formed by seven rectangular elevations, each elevation divided into two squares, and each square vaulted by one arch. [31] The north and south corner elevations are larger than the other internal five. Each is framed by supporting columns and each "story" or "floor" is framed by a belt course which embraces the entire building. The structural relationship between the seven elevations is "suggested" by the belt course, and is finally achieved by the elaborate main cornice which crowns the building. This transaction is very smoothly accomplished by indicating the main cornice's themes on the secondary cornices located on each third of every supporting column, which serve as gracious supports for the arches that vault each square's elevations. [32]

At first glance, the structure appears massive; but in last consequence, it is not. First the building's formal balance is broken by the unequal size of two of the rectangular elevations as on the east facade. The other five are also unequally distributed as the central elevation is walled. Three tensions are evident in the east facade: the outside pulling force of the larger arches of the north and south corners, the settling forces of the central or "filled" elevation,

and the upward direction of the intermediate elevations. In other words, there are three distinctive forces which push in three different directions and are held together by the horizontal lines of the subsidiary cornice, the belt course, and the main cornice, all counterbalanced by the sinuous lines of the arches. The composition, especially the west facade, was brilliantly achieved. [33]

The outward pushing tendency of the four cornices of the building posed a serious problem to the architect since he had to discharge them in a very appropriate fashion. This was successfully achieved by the ramp of the south facade. First of all, visually speaking, the architect was able to rest the main cornice on the highest point of the ramp; and second, he established a structural relationship or correlation between the main cornice and the building's arches with the top of the ramp and the half sunken arch beneath it. That is, the slope of the ramp's lateral walls, which "grow" from a point very close to the main cornice, at first, is very steep, but is later modified by the perpendicular fall which changes the horizontal line of vision and allows for the slow descending that ends, finally, in the ramp's entrance, which was designed as an open, cup-shaped form terminating in a tuft. This sloping effect is the means through which the massiveness is controlled. The south elevation corroborates this analysis. [34]

At this stage, it can be argued that the building's exteriors do not correspond to a traditional industrial space. But this is not the case. The imposing Spanish Colonial, church-like, south facade opens not on the first floor --which would have added massiveness-- but on the second. The ascending effect along the ramp's slope actually lightens and balances the facade's formality. Nevertheless, access to the building through the second floor solved a functional and fundamental industrial problem since it was on the second floor of the south room that the old vertical cattle-driven mill had been installed between the 1790s and the 1820s. The actual reason for the mill being on the second floor had to do with the flow of the sugar cane juices which, in the absence of pumps, were carried by gravity to the north room where the boiling pans were probably stationed.

From the original entrance, now walled, the building's true magnificence in architectural and utilitarian functions can be observed. [35]

The original floor plan is a rectangle (north to south), dived into two squares by a wall (east to west). The wall coincides with the "filled" external elevations already described. Two parallel pairs of arches run from the south facade to the central wall which acts as a pier from which both arches extend to the north facade. The span of the arches --all brick and masonry, lacking a keystone-- are slightly different. The south room arch is larger than the north's because the ramp partially acts as a buttress, but the absence of a ramp on the north facade necessitated the reduction of the arch span

as the piers are attached to the walls in the north facade and the central wall respectively, thus reducing space. This is the reason for the extra thickness of these walls at those particular points.

The arches created the necessary industrial spaces for both the old mill and probably the boiling pans. If further corroboration is required for this assertion, it would be interesting to excavate the two visible flues in the west corner of the west facade which might be the old --1790-1830-- Jamaican train flues. [36] If so, then the old crystallizing pans might have been located --following a traditional arrangement-- in the east section of the north room. It should also be considered that the flues might correspond to the 1930's installation of the boiler, since the 1902 description of the machinery states that the boiler was stationed in the same room as the steam engine. [37] It is also possible that the boiler was installed where the old Jamaican train had been. In other words, the boiler might have been stationed between the steam engine and the old defecators or perpendicular to the defecators and in front of the steam engine, flywheel, and reduction gears.

The arches were a subject of major transformations in the 1830s, as already pointed out. But those in the north room were skillfully transformed into three smaller arches, two of which hage a larger span than the central one. The height of the new supporting cast iron arches was less than the original brick and plaster arches. Therefore, the space left between them was filled with brick and plaster following the same techniques as in the old arches. The cast iron arches have a slight resemblance to English Tudor four-centered arches. They rest on cast iron, fluted columns. The arches and columns were strengthened with the addition of tie rods. There is no doubt that the renovations were expertly done, as they retained a clear stylistic relation to the old structure and respected the harmonious relationship between internal and external characteristics. [38]

One question remains unanswered: why were the hacienda and building named after Santa Elena (Saint Helene)? Santa Elena, mother of Constantine the Great, was a Roman empress who lived during the third and fourth centuries, A.D. She was converted to Christianity in the early fourth century. Traditionally, she has been associated with the findings of Christ's cross and nails in Jerusalem. In terms of art, "she is shown as an empress, with crown and imperial mantle, and usually with the Cross and the Crucifixion nails." [39] A painting depicting "Santa Elena" actually hung between the partially engaged columns in the north room niche. [40] The columns have a Corinthian base, half-fluted shaft, a Doric-type capital, and rest on an undecorated corbel. The painting is missing from its original place, but the metal rod from which it hung is still in place. Finally, the church-like resemblance of the structure was accentuated by a curious fact: the tolling of a 500-lbs. bell --missing-- was probably used for calling the slaves of the entire region, since the tolling could be heard as far away as the towns of Bayamon and Vega Baja, each almost ten miles away.

The structure is decaying. The two-hundred-year-old imposing and elegant building --possibly the only one of its nature in the Caribbean-- is crumbling into red-pink dust. Its formidable lines are blurred by falling plaster. The passing of time vanishes spaces: the roof is gone, the walls are denuded, exposing bleeding bricks, and dirt is taking over.

Footnotes

1. J. Ferreras Pagan, Biografia de las riquezas de Puerto Rico. Riqueza Axucarera, Vol. 1 (San Juan, 1902), and Jaime Bague, Del ingenio axurarera partriarcal a la central axucarera corporativa (Mayaguez, 1968).

2. Puerto Rico 1977 HAER, Hacienda "Santa Elena Drawings," p. 3. Hereafter quoted as SED.

3. On separate folder.

4. The San Juan fortifications were finished in 1796, by the time of the last British attack on the island.

5. Ferreras Pagan, 17.

6. Archivo General de Puerto Rico (AGPR), Ponce Notarial Records.

7. Ferreras Pagan, 17.

8. Ibid, 17.

9. The interview was not taped. Field notes were taken, edited, and are filed with this report. It took place at Fonalleda's "Tres Monjitas Dairy Farm" offices in Hato Rey, Puerto Rico. Present were Geronimo and Ferardo Fonalledas, HAER historians Hector Sanchez and Benjamin Nistal-Moret. The third team historian, Javier Melendez, was also present. He resigned his position on August 9, 1977.

10. There is no doubt that the sugar world Geronimo Fonalledas saw as a child and described by him as a "fairy tale" played a fundamental role on his decision to become a sugar engineer. He received the degree from LSU in the early 1920s, thus becoming one of the first professionals in his field in Puerto Rico. There is one striking fact about Geronimo Fonalledas: the highly precise and fresh memories he has of the events that occurred almost seventy years ago and, more so, when everything he said has been corroborated and found accurate.

11. This interview was taped and is filed with this report. It took place at Hcienda "Santa Elena" on August 3, 1977. Present at the interview were Gerardo and Geronimo Fonalledas, architect Robert Fraga, and historian Benjamin Nistal-Moret.

12. SED, p. 3.

13. For unknown reasons, this important finding was not incorporated into the drawings by the Supervisory Architect, especially in SED, p. 2. It is possible that the Jamaican train and crystallizer's room was added to the old structure as a result of the hacienda's mechanization. No sustaining evidence has been found in this respect with the exception of the secondary sources.

14. SED, p. 3

15. Ibid, Plan 1790-1830.

16. Ibid, also SED, p. 4, B-B.

17. SED, p. 2: East Elevation; p. 4: South and West Elevations.

18. Santa Elena photographic recording A52-55. Hereafter quoted as SEPR.

19. SED, p. 4.

20. SED, p. 3: Plan 1820-1910.

21. Ibid, and p. 4, B-B.

22. Ibid, pp. 3-4.

23. SED, p. 5: Cast iron column and arch.

24. SED, p. 5: Niche.

25. For unknown reasons, this important finding was not incorporated by the Supervisory Architect into the SED

26. See the 1910's "Santa Elena" photos.

27. Bibiano Torres, La Isla de Puerto Rico, 1765-1800 (San Juan, 1968), p. 22ss.

28. Fray Inigo Abbad y Lasierra, Historia geografica, civil y natural de la Isla de San Juan Bautista de Puerto Rico (San Juan, 1970), p. 165. Originally published in 1788.

29. Ibid., p. 122.

30. SED, p. 2: Est Elevation. SEPR, A47-9, B23-4.

31. SEPR, A56-8.

32. SEPR, A52-5.

33. SED, p. 4: West Elevation. SEPR A63-9.

34. Ibid, South Elevation. SEPR, A50-1.

35. SEPR, A73-80; B14-9.

36. SEPR, A70.

37. SED, p. 2; Plan, p. 3: Approximate machinery location plans.

38. SEPR, A81-7; B3-13, 21, 25-6.

39. McGraw Hill Dictionary of Art, Vol. 3 (1969), p. 78.

40. SED, p. 5: Niche; SEPR, A88, B1-2.